

# Artificial Intelligence — Final Test

Armando Tacchella

January 10, 2022

## 1 Propositional Logic

Formalize the following facts in propositional logic

1. It is not the case that if Paolo has a job then also Mary has a job.
2. If Paolo has a job and Mary has a job, then Roberto has not a job.
3. If Mary and Roberto have a job then either Paolo has a job or Mary has not a job

and show whether they are consistent or not. Prove your answer using either Variable Elimination or DPLL.

## 2 Logic

Formalize the following statements in First Order Logic:

1. No one is a friend of oneself
2. If a person is a friend to another person, then also the latter is a friend of the former (friendship is mutual).
3. The friends of the friends of a person are also friends of that person (“the friends of my friends are also my friends”).

Answer the following questions, providing proofs reasoning on interpretations:

- Are the sentences consistent?
- Given the domain  $D = \{mary, susan, juliet\}$  and the interpretation function  $g$  such that  $g(AreFriends) = \{(mary, susan), (susan, juliet)\}$ , tell whether the interpretation satisfies all the sentences or not;
- Tell whether the sentence “There is at least one person who is everybody’s friend” is a logical consequence of the statements or not.

### 3 Planning

Using PDDL-STRIPS formalize a domain of intermodal transportation considering the following constraints:

- a container can travel from a logistic hub to another logistic hub by truck only if the hubs are in the same country; also, a container can travel to/from a train station and a logistic hub by truck as long as the two places are in the same country; finally, a container can travel between two train stations if they are in a different country;
- to be loaded on a truck, the truck and the container must be at the same place (hub or train station); a truck can carry only one container;
- to be loaded on a train, the container and the train must be at the same place (train station); a train can carry four containers;
- a container must be unloaded from a truck to be loaded on a train;
- a truck can travel between hubs located in the same country, or between a hub and a train station; a train can only travel between train stations.

In particular, formalize a situation where:

- there are four hubs located in two different countries (say Italy and France) with two hubs per country;
- there are two freight train stations, one per country; there is one train, initially located at the train station in Italy;
- there are eight containers, initially located at the hubs in Italy, four containers per hub;
- there are four trucks, initially located at the four hubs (one per hub)

The goal is to have all the containers reach the two hubs in France. For instance, if containers are numbered from 1 to 8, and the French hubs are numbered from 1 to 2, the first four containers should reach French hub 1, while the other four should reach French hub 2.